R E P O R T R E S U M E S

ED 016 245 08 CG 001 231

ATTENTION DIRECTING TECHNIQUES USED BY TEACHERS, ATTENTION AS A VARIABLE IN TEACHING RESEARCH. FINAL REPORT.

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REPORT NUMBER BR-6-8183 PUB DATE SEP 67
GRANT OEG-4-6-068183-1837
EDRS PRICE MF-$0.25 HC-$1.92 46P.

DESCRIPTORS- *ATTENTION, *ATTENTION CONTROL, *RESEARCH PROJECTS, ATTENTION SPAN, TASK PERFORMANCE, TABLES (DATA), *TEACHING TECHNIQUES, GALVANIC SKIN RESPONSE

RESEARCH LITERATURE ON ATTENTION WAS REVIEWED, APPROACHES TO THE MEASUREMENT OF ATTENTION IN A CLASSROOM SETTING WERE STUDIED, AND CLASSROOM EXPERIMENTS IN WHICH ATTENTION WOULD BE STUDIED AS A DEPENDENT OR INDEPENDENT VARIABLE WERE DESIGNED. THE RESEARCH LITERATURE INDICATES THAT NOVELTY, VARIETY, CHANGE, AND COMPLEXITY ARE VARIABLES RELATED TO INCREASED ATTENTION. THE FIRST EXPERIMENT ATTEMPTED TO DETERMINE OVERT BEHAVIORAL CORRELATES OF A PHYSIOLOGICAL MEASURE OF ATTENTION. GLAVANIC SKIN RESPONSE (GSR) RECORDS WERE MADE OF SUBJECTS WHILE THEY LISTENED TO 32 WORDS PRESENTED IN BLOCKS OF EIGHT. THE PRESENTATION OF THE BLOCKS WAS VARIED BY CHANGED TONE OR THE ADDITION OF A TONE. NO OVERT BEHAVIORAL CORRELATES COULD BE RELATED TO THE GSR. THE STIMULUS CHANGES AFFECTED THE RECALL OF WORDS. ANOTHER EXPERIMENT STUDIED THE RELATIONSHIP BETWEEN PERSISTENCE AND TASK DIFFICULTY. SUBJECTS EXPOSED TO A TASK OF MEDIUM DIFFICULTY PERSISTED LONGER AT THE TASK THAN SUBJECTS EXPOSED TO VERY EASY OR VERY DIFFICULT TASKS. HOWEVER, THE RESULTS WERE NOT STATISTICALLY SIGNIFICANT. IN A SEPARATE STUDY, POPULATIONS OF LEARNING TOPICS FROM TENTH GRADE VOCATIONAL AGRICULTURE WERE DEFINED. THE IDENTIFICATION OF TOPIC POPULATIONS MAKES POSSIBLE APPLICATION OF TREATMENTS TO THE POPULATION. A MODIFIED MULTIDIMENSIONAL SCALING APPROACH YIELDED FIVE FACTORS AMONG 20 TOPICS. (AUTHOR/PS)

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FINAL REPORT
Grant No. OEG-4-6-068183-1837

ATTENTION DIRECTING TECHNIQUES USED BY TEACHERS: Attention as a Variable in Teaching Research

September 1965

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Office of Education Bureau of Research

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ATTENTION DIRECTING TECHNIQUES USED BY TEACHERS:
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Grant No. OEG-4-6-068183-1837

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September 1967

The research reported herein was performed pursuant to a grant with the Office of Education, U. S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

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ACKNOWLEDGEMENTS

Several people contributed to the project. Robert McFarlane of the Speech and Hearing Laboratory at Colorado State University was very helpful with technical advice, and in allowing the use of their equipment. Paul Berlfein and Sharon Blake served as assistants on the project for part of the period.

The teachers, judges, and experiment subjects should also be cited for their work on the project.

Mrs. Maureen Sheard contributed, in her fine manner, those secretarial skills that are indispensable to any research endeavor.

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INTRODUCTION

Attention is an important variable in education that has had surprisingly little attention from educational researchers. Teachers have an intuitive understanding that one of their important tasks is to direct the attention of the student to the important elements of a learning situation. This understanding is reflected by the common use by teachers of the two words "pay attention."

Although it is generally agreed that the attention level of the student in a classroom is related to the learning by the student, there is little empirical evidence on this hypothesis from classroom settings. One result of the lack of research on this topic is that there is little information on techniques that a teacher might use to effectively direct the attention of the learner in the classroom.

There are several likely reasons for the limited work in this area. One reason may be that the need for attention is so obvious that there is a feeling of no need for research. A second possible reason is that attention as an area for study has had an "on again--off again" history in the basic behavioral science disciplines. The behaviorist school, until the last few years, has tended to disregard attention probably because of the mentalistic connotations associated with the concept. It is interesting that the study of attention is now in an "on again" stage.

In the opinion of the investigator, a primary reason for the lack of study of this important concept in the classroom is the measurement problem. Direct measures of attention are not available and the indirect measures that have shown some validity are generally physiological measures that, at the present stage of technology, are not administerable to a group in a classroom setting. As a consequence, attention has been treated as an intervening variable rather than as an independent or dependent variable. Where attention has been explicitly studied it has been measured very indirectly by relating achievement to stimulus changes or properties. The inference in these situations is that if the stimulus change has an influence on attention level this variation in attention will be directly related to variation in achievement. This very indirect measurement does not provide well for precise study of attention.

The purpose of the project reported in this paper was to review research on attention, to study approaches to measurement of

attention in a classroom setting, and to design classroom experiments in which attention would be studied as a dependent or an independent variable.

The report is organized in the sequence outlined above. The next chapter is a review of relevant research, the third chapter describes a study in which an attempt was made to devise a measure of attention and another study on persistence as an aspect of attention, and the fourth chapter describes some possible classroom approaches to the study of attention. It should be mentioned here that little success was attained with scale development which limited the definitiveness of the discussion on classroom experimentation.

Chapter 2

REVIEW OF LITERATURE

The fact that attention has not been the subject of much educational research is illustrated by the notable lack of space accorded the topic in educational methods textbooks. The indexes of twenty methods books were examined and the term was indexed in only four of the books. In three of the books the term indexed was actually "attention span."

Despite this apparent ignoring of an important concept by the educational researcher, the classroom teacher does not ignore it. Very likely most teachers are quite conscious of the principle expressed by Kagan (1966) that "If the child pays close attention to information that is presented to him, either by book or speech, he is likely to learn something important about the information." Being conscious of this principle, most teachers do use certain techniques which they believe increase the likelihood of the child paying "close attention." That these techniques are effective is not disputed. Many are based on psychological research on attention; many are based on trial and error or intuition. That these techniques are not always effective is also not disputable. Not all students do attend to what the teacher intends. It seems to this writer that it would be desirable, if not necessary, that intensive study be directed at the topic of attention in the classroom. Findings of psychological research in this area and related topics need to be studied in classroom settings. Such research would be very useful for teachers by allowing them to know what techniques might increase the likelihood of a student's attending to the material to be learned.

The purpose of this review of literature is to present some of the findings on attention and related topics and discuss their application to the classroom.

Several early psychologists devoted considerable effort to the study of attention. Four who wrote much on the topic were James (1890), Pillsbury (1908), Ribot (1898), and Titchener (1908). Of these four, the views of James and Titchener are most interesting in that they presented the two aspects of attention that seem to still guide the research on the topic today.

James considered attention to be a violational act on the part of the individual. He stressed a cognitive and motivational aspect to attention as exemplified by his statement that "the things to which we attend are said to interest us" or "my experience is what I agree to attend to." Thus, according to James, the organism selects those aspects in his environment to which attention will be given, and this selection is primarily determined by the interests of the individual. James further indicated that this attention is voluntary and derived, thus learned. James recognized that attention might be passive and determined by sudden changes in the environment, but this kind of attention he attributed primarily to childhood and suggested that, with maturity, stimulus controlled attention was of little consequence.

Titchener, on the other hand, emphasized that attention was influenced or directed by characteristics of the stimulus. He suggested that attention is directed to sensations with maximal clearness in consciousness and the clarity of the sensations was determined mainly by characteristics of the stimulus. Eight conditions of clearness were described by Titchener as follows:

1. Intensity of the stimulus
2. Quality of the stimulus
3. Temporal relations especially repetition and suddenness
4. Movement
5. Novelty or strangeness
6. Presence in consciousness of corresponding ideas
7. Accommodation of sense organs
8. Change

These views of James and Titchener are not mutually exclusive, but they do illustrate the two trends that have been pervasive in research on attention through the years. The phenomenologists and the cognitive learning theorists would likely be disposed to the James viewpoint, whereas the behaviorists would tend to consider attention as Titchener has.

Attention as an Act

As indicated previously, attention can be considered a conscious act on the part of the organism. This conception of attention places heavy emphasis on motivation especially interest. Much of what is done by the teacher in the classroom is based on such a conception of attention. When the teacher attempts to structure the lessons so that the needs and interests of the students are met she has in effect applied this conception of attention. The inference of the

oft cited admonition to teach to needs and interests is that such teaching will strike a responsive note in the student and he will attend to the material. It is unfortunate, however, that the admonition is difficult to apply in a classroom setting because of the varied needs and interests of the students and the difficulty of assessing what they are.

There is considerable research evidence to support the contention that attention is a voluntary act on the part of the organism. Hebb (1955) hypothesized that sensory events have two different effects on the organism. One effect is to guide and direct behavior, and the other is to arouse the organism. The latter function is related to the general drive or motivational state of the organism. The Hebb hypothesis infers that the organism seeks an optimal level of stimulation. The Hebb hypothesis has been supported by many researchers but the work of Berlyne (1960) seems to have special relevance for the teacher.

Berlyne distinguished between two types of exploratory behavior. Curiosity as exploratory behavior results from the organism having a lack of specific information and exploratory responses will be made to resolve this lack. This notion of curiosity is similar to the "need to know" that has been discussed by Butler and Harlow (1951). The second type of exploratory behavior described by Berlyne was called "diversive exploration." Such behavior results from general lack of stimulation of the organism and as a consequence the organism seeks stimulation.

According to Berlyne the curiosity type of behavior can be aroused by novelty and complexity of the stimulus. Subjects in his experiments have been found to spend more time looking at changing patterns than at static ones and at complex figures rather than simple figures. Day (1966) has replicated this latter finding.

The "optimal level of stimulation" notion implies that one can arouse too much curiosity or diversive exploration type of behavior. What the effect of exceeding the optimal might be has not been well studied but the expectation would be behaviors such as confusion, disorientation, and perhaps withdrawal. Lumsdaine and Gladstone (1958) reported that what might be considered unnecessary embellishments in a film made the film less effective as a teaching device than a "plain" film. This finding suggests that the optimal level of complexity had been exceeded in the embellished film with a possible result of confusion on the part of the learner. Ryan and Schwartz (1956) reported a similar finding in a comparison of cartoon drawings with high-fidelity photographs. Recall was better of the material in the cartoon drawings than in the photographs.

Curiosity and diverse exploration do seem to be helpful concepts for thinking about attention and they do have implications for the teacher. Novelty or variety in teaching procedures would seem to capitalize on curiosity as well as provision of a certain amount of complexity in the material presented. The teacher should keep in mind, however, that the relationship is likely curvilinear between these variables and attention. Too much novelty, variety, or complexity will likely result in as little attention as too little novelty, variety, or complexity.

Although curiosity and diverse exploration are useful concepts and likely explain many attentive behaviors, they do not adequately explain all attentive behaviors. One such behavior is the attentive behavior associated with learning set. An example of this kind of attentive behavior is that called for in one kind of incidental-intentional learning experiment.

Mechanic (1962) has described the two general types of such experiments. In one design the subject is presented with materials and asked to perform a task which does not require learning of the material. The subject, after completing the task, is then asked to recall the material. In the second design the subjects are asked to learn a portion of the material presented to them. After completion of the task the subject is asked to recall not only the material they were instructed to learn but also material that they were exposed to but not instructed to learn.

An entire body of research literature has developed in this area and in general the experiments employ one of the above designs or variations on them.[1] The second type of design described above is most relevant to this discussion. The typical result of experiments employing the second design is that the subject recalls better the material which he is told to learn than the material which is presented incidentally. Although attention has not generally been measured in such experiments, a reasonable interpretation of the results is that the instructions have induced a set to attend to certain material and the attention given to the material has facilitated learning.

It is difficult to explain this kind of attention as curiosity behavior. Certainly the subject responds to the directions for some reason, but the reason could be a desire for social approval

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[1]No attempt was made to cite all the studies. Several studies by Postman and associates are referenced as examples of research in this area.

or some other motive than curiosity. On the other hand, it is possible that the instructions are effective because of curiosity or a need to know. The subject coming into the experiment, if a need to know exists, is an organism who strives to learn in every situation. In this case the instructions would then serve to cue the individual to what can be learned or what is significant to learn in the presented material.

Whatever the reason, the evidence is that set inducing instructions do facilitate learning and it is reasonable to infer that facilitation is due in part to the direction of attention that ensues.

That the establishment of learning set is facilitative of learning in classroom settings has also been demonstrated. Ausubel and associates (1960, 1961, 1962, 1963) in a number of experiments have demonstrated that the reading of "advance organizers" prior to the study of a topic facilitates the learning of the material in the topic. Although Ausubel did not indicate that the "advance organizers" were set inducers, Wittrock (1963) did obtain results to suggest that the organizer did serve this function.

From such results certain implications can be made for the classroom teacher. Learning sets can be established that will serve to direct attention to what has been learned. Introductions to learning situations that alert the student to what is to be learned and statements that relate what is to be learned to what the student knows should be useful in establishing learning set or directing attention.

Attention as a volitional act on the part of the organism is supported by research. Furthermore, the research on this view of attention does provide suggestions for application in the classroom. Novelty, variety, and complexity of stimuli when used at some optimal level for an individual will increase the likelihood of his attending to the stimuli. Attention can also be directed by introducing a learning task in a manner that will induce a set for the task by indicating what should be attended to in the task.

Attention as Controlled by the Stimulus

Attention when regarded from the frame of reference of being under the control of the stimulus is basically the Titchener position. Those who hold the position that attention is a volitional act argue that the organism will not attend to the stimulus unless some motive or interest is aroused by the stimulus such as curiosity. What we have, in effect, is the free will versus determinism argument again and the arguments in this controversy have been well

presented elsewhere. Suffice it to say that the person who regards attention as being under the control of the stimulus generally holds the position that motives or needs are not needed to explain the behavior. This then is really the behaviorist approach. Control the stimulus and attention is controlled, the why is not important or, perhaps it is better to say, not observable.

There is considerable research evidence to support the contention that attention is controlled by stimulus properties. The work of Berlyne, in fact, supports this viewpoint in that novelty, variety, and complexity are stimulus characteristics that are related to attention. If these characteristics are varied, attention will vary and it is unnecessary to introduce motives to observe the controlling effect.

The incidental-intentional learning studies mentioned earlier also provide support for attention being related to stimulus characteristics. In the design in which the subject is instructed to learn certain of the material, the manner of presenting the accompanying material has been varied in some experiments.

It has been observed that recall of the incidental material is related to characteristics of the incidental material. Color, contiguity, and form have each been shown to be related to recall of the incidental material.

Generally the research in this area has demonstrated that changes in stimuli are related to attention. Varying color, tone, intensity, form, movement, speed, size, etc. of the stimulus would be expected to affect the attention of the organism. Lumsdaine (1963) has reported experimental results of various researchers that support this contention and Broadbent (1959) is also an excellent source of studies with supporting data.

Maltzman and Raskin (1966) have reported on the fact that Russian investigators have identified an orienting reflex that accompanies changes in stimulation. Furthermore, Maltzman and Raskin reported results to indicate that there are individual differences in the strength of the orienting reflex. Hernandez-Peon (1966) has reported a number of studies on the physiological bases of attention and among other things his results have indicated that the effect of stimulus change on attention is related to the degree of stimulus change and the degree of attention to the task being done before the stimulus change.

What this research indicates for the teacher is that there are measurable physiological effects when stimuli are changed in various ways. Consequently, it would be expected that variation

of stimuli is causing arousal, increased awareness, or some sort of focusing on the stimulus that has changed. Thus attention is directed to the stimulus that has changed. Variety then again seems to be supported as a useful technique for directing attention.

If attention is regarded as a response to stimulation, then the question arises whether this response can be conditioned? Maltzman and Raskin (1966) reported that Russian researchers had conditioned the orienting reflex. They further reported, however, that the reflex becomes extinct quickly with excessive presentations of the conditioned stimulus. One is reminded of the "cry wolf" fable.

Reports of two experiments were found in which attention span had been affected by the use of operant conditioning procedures. In both of the experiments (Kerr, 1962; Martin and Powers, 1967) the subject's behavior was verbally reinforced when the behavior indicated attentiveness to the task at hand. Other behaviors were ignored. The results indicated that the attention span for a task was increased significantly by operant conditioning. Martin and Powers in discussing the results pointed out that the usual procedure of the teacher is to respond to the student only when the student stops attending to the task. They suggested that such responses may be reinforcing in some way to the student so that he is reinforced for ceasing to attend. To increase the attention span the teacher should reinforce attentive behavior and not reinforce non-attentive behavior.

Gibson (1963) wrote that the individual learns to select and respond to critical features and ignore noise or redundant features of the stimulus. Thus the child learns that changes in tone or intensity of voice, underlined words, variation in color, and other kinds of variation in stimuli are signals of critical features of the stimuli.

Programmed instruction is an example of a teaching situation in which attention is purportedly controlled by the stimulus. Among the cited advantages for programmed instructions is that the technique insures attention. (Skinner, 1954). This insuring of attention is supposedly accomplished by two characteristics of a program; active responding and successful performance. The person studying a program must respond to the program and this feature forces attention. It is reasonable to believe this assumption is correct, but it is interesting that there is little empirical data on the relationship between active responding and attention.

The other attention directing characteristic of programs is that successful performance is achieved. Successful performance purportedly will serve to affect the attention span in that a person who is successful at a task should be willing to persist longer at the task than if unsuccessful. Although there are data to support this assumption, the relationship is probably more complex than simply that if the individual gets more of the items correct in a program he is likely to be willing to persist at the task for a considerable period of time. The complexity of the relationship, in the present writer's opinion, stems from what defines success. It would seem that success at a task has to be defined not only in terms of whether the response is correct but also in terms of the individual's subjective probability of being correct. The second experiment reported later in this manuscript was designed to study this question. A review of literature relevant to the question is included in the report of the experiment.

Summary

Whether attention is regarded as an act of the individual determined by his motives, needs, interests, etc. or as a response by the individual to stimuli does not seem to make much difference when one considers the question of direction of attention. From either frame of reference the techniques are the same. Novelty, variety, change, and complexity are the key terms. The teacher can expect facilitation of attention with the introduction of novelty, variety, change, and complexity into the learning situation. The teacher should recognize, however, that the relationship between these variables and degree of attention is probably curvilinear. Too much will be as inhibiting of attention as too little.

That attention behaviors are learned is also a finding of significance for the teacher. A student can be taught to attend to relevant features of the stimulus. The learning set studies have demonstrated this. Techniques of proper introductions to new learning situations will facilitate the learning. Furthermore, it appears likely that attention span to a specific task can be increased by reinforcing attentive behavior in the task and not reinforcing non-attentive behavior.

In the next chapter, two experiments are reported. One experiment was designed to develop a measure of attention and the other was designed to study the effects of material difficulty on persistence in a task.

Chapter 3

RESULTS OF EXPERIMENTS

Experiment A

The purpose of the first experiment was to study the problem of measuring attention. Until a reliable measurement of attention is available for use in classroom situations, it will be very difficult to study in a definitive way attention in the classroom. Inferences from achievement measures are so indirect and achievement is so much related to other variables that these measures cannot really tell us much about attention.

The approach taken in the experiment was to attempt to determine whether any behaviors that would be observable in a classroom setting were correlated with scores on a physiological measure of attention. If such behaviors could be identified then a rating scale or check list type of instrument could be developed for obtaining a measure of attention in the classroom.

Certain physiological changes have been observed which are used to define the orienting reflex. The changes include the galvanic skin response, pupil dilation, blood volume changes, and changes in the alpha wave rhythm. The orienting reflex is likely an aspect of attention so that measures of changes in these physiological responses could be considered a measure of attention. Eye movement is another physiological measure that has been used to measure attention. (Day, 1964; Guba and Wolf, 1964; Day, 1967). Ruff (1963) reviewed validity data for many psychological and psychophysiological measures. He indicated that skin resistance was often used to measure alertness and that it appears to respond to stimuli that increase the subject's responsiveness to his environment. On the basis of this review and data in an article by Burch and Greiner (1960) it was decided to use skin resistance as measured by the Galvanic Skin Response as a physiological measure of attention.

The rationale for the experiment that was conducted was that if attention is affected by a change in stimulation and if the Galvanic Skin Response (GSR) is a measure of attention then persons who are exposed to changes in stimulation will exhibit a GSR following the change in the stimulus. Further if there are observable

behavioral correlates of attention, these behaviors will be observed at a time contiguous with the onset of the GSR. It was also reasoned that if the task were a learning task such as a recall task, the performance of the subject would reflect an influence of the stimulus change.

Method

The task selected for the experiment was a listening task. Each subject listened to a list of 32 words presented via tape while connected to a GSR recorder. The presentation of the 32 words was varied systematically as the independent variable.

The 32 words were selected from lists developed by Peterson and Lehiste (1962). The words selected were words that occurred 50-99 times per million words in the Thorndike-Lorge count and words for which the phonemic distribution was constant.

The list of 32 words, presented in Table 1, was taped in the normal speaking voice of the investigator with the words spoken at a two second interval. The recording speed was 7½ inches per second with a frequency of 60 cycles per second.

Table 1

Words used in the Experiment

bush	hide	load	noise
match	rope	pan	tip
coin	nurse	wheat	cheer
loud	lock	search	pack
kid	lean	rail	pile
net	dish	tone	wire
cat	shut	bought	gaze
wake	nail	tower	bone

The basic list was then used to establish three conditions as follows:

A condition - words presented in the normal speaking voice.

B condition - words presented at a higher tone than the normal speaking voice. This was accomplished by duplicating the tape at a frequency of 62 cycles per second.

C condition - words presented in the normal speaking voice with an extraneous harmonic tone occurring at the same time.

The B condition resulted in the word being said somewhat faster than normal so that this condition was not only a change in tone but also a change in speed. The increase in speed was 3.3 per cent. The harmonic tone in the C condition was selected from tones generated by a harmonic generator such that the tone was noticeable but not interfering. The words under all conditions were judged by 10 graduate students on recognizability of the condition and intelligibility. The conditions were discriminated by the students with no apparent difference in word intelligibility. The judges recognized all of the words.

The conditions were established for blocks of eight words and nine tapes were made to establish nine experimental treatments. The words were presented in the same order in each treatment. The nine treatments were as follows with a letter representing a block of eight words: AAAA, AAAB, AAAC, AABC, AACB, ABCA, ABAC, ACBA, and ACAB. The first eight words were always presented in the A condition to establish a constant introductory experience for all subjects. The last twenty-four words were then presented in the different orders as indicated.

Twenty-seven subjects were used in the experiment with three assigned at random to each treatment. The subjects were high school seniors. When a subject arrived for a session he was screened with an Ambco audiometer. No subjects were eliminated by this screening.

Beckman electrodes were then placed on the palm and the back of the hand of the subject and the electrodes were connected to a Grass Model 7 Polygraph. The subject sat at a table in a sound deadened room that was about eight feet square. The room was the Industrial Acoustics Company Model 403 room. The subject sat in this room for ten minutes reading a magazine while his basal resistance level and sensitivity were established. The subject was then informed of what the task was and five words were presented via tape as an example of what would be heard. The subject was told that the experiment was designed to study physical reactions while listening to words and that he would hear a list of words presented via tape. He was told that he would be tested over how many of the words he could recall after the list had been presented.

After the subject had heard the five example words, his basal and sensitivity levels were again checked and then the list of 32 words was presented under his assigned treatment condition.

While the subject was listening to the list of words, one experimenter observed the subject through a window in the room. The window was situated behind the right shoulder of the subject and the outside room was darkened so that the subject did not know he was being observed. The observer recorded all observable behaviors of the subject during the treatment and the other experimenter would record on the GSR record tape when the behaviors occurred.

The expected results of the experiment were that the stimulus change between the blocks of eight words would affect the attention of the subject and that this would be reflected by a GSR at that point. It was further expected that there would be observable behaviors that occurred at the same time, and that the recall of the words would be related to the stimulus change.

Results

The data in Table 2 are the GSR data of the subjects. The GSR was converted to a change in conductance and the numbers reflect a measurable increase in conductance level. The measure was taken by computing the difference between the high and low points in the interval following a word and only in those instances where there was an inflection in the recording.

It is obvious from the data in Table 2 that there was no indication of a consistent GSR associated with any of the stimulus changes. Had there been an association there would have been consistent GSR's in the interval following the ninth, seventeenth, and twenty-fifth words in those treatments where the stimulus changed at that point.

Although the subjects exhibited observable behaviors during the treatments, these behaviors were not associated with the stimulus changes nor with the GSR's that did occur. Thus the expected outcomes in this regard were not observed and little progress was made toward the goal of a measure of attention.

The data in Table 3 indicate that the conditions had an effect on recall. The recall task for the subject was to select from a list of 64 words those words that he had heard. The list of 64 words contained the 32 words presented plus another 32 selected from the same pool. The data in Table 3 are the cell means of the number of words recognized from the last three blocks of eight words in the list of 32. The data are presented only for those six groups that were exposed to all three stimulus conditions.

Table 2

GSR of Subjects Following Each Word in the List
(Only conductance increases are recorded)

Condition		Word 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
AAAA	1.	.46			.07								.02				.08
	2.				.01												.01
	3.	.11	.01	.03	.01			.01	.02	.01		.03		.03		.02	.03
AAAB	1.	.01		.29		.05		.03	.02	.05			.02	.03	.02		
	2.	.02	.01				.01					.01				.02	
	3.		.09			.01				.01							
AAAC	1.	.07		.12													
	2.	.08	.27	.15	.03	.03	.02	.02	.06	.06					.18		.02
	3.		.13	.02			.01	.04			.09			.10	.05		
AABC	1.		.21			.15			.06			.11				.01	.09
	2.		.27	.04			.07		.30		.01		.02			.04	
	3.	.09	.08		.19		.01	.03		.01	.01				.02	.01	
AACB	1.		.02		.01		.01		.01	.01				.01			
	2.	.06					.03			.02	.03		.02				.01
	3.	.05	.01	.04	.03		.01	.03		.01				.01		.07	
ABCA	1.	.04	.31		.01			.03	.03		.08					.04	.14
	2.	.26	.04	.08	.07	.03		.02	.07	.08	.08		.14	.01	.04	.09	
	3.		.11							.09			.02				
ACBA	1.		.16		.01							.01			.01		
	2.	.04	.02	.02		.03	.01	.01		.02		.02			.01		.01
	3.	.01	.16	.03													
ABAC	1.							.01								.02	
	2.	.16			.04			.08							.01		
	3.	.03	.01	.02					.02		.01	.02				.01	
ACAB	1.		.13								.01				.01		
	2.	.12	.21									.01			.09		
	3.		.04	.02						.01							

Table 2
(continued)

Condition		17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
AAAA	1.	.02	.03	.03		.03		.05			.02				.03		.15
	2.					.01					.04						
	3.	.01			.04					.05	.01					.01	
AAAB	1.	.07		.02	.03	.03	.03		.02		.05	.03	.01			.06	
	2.				.01			.01		.01					.01		.01
	3.																
AAAC	1.	.01	.11	.05			.01										
	2.	.16		.01	.01	.01			.01	.01	.09		.01			.04	
	3.	.01		.04			.04				.20		.03			.02	.04
AABC	1.		.04		.05						.01		.02			.12	
	2.	.14		.07	.10	.04			.04		.09					.09	
	3.					.01			.02				.03	.02	.04		
AACB	1.	.01				.01					.01	.01		.01		.01	
	2.		.03		.01		.04	.01	.04			.02	.05			.02	
	3.	.07	.02						.03		.02		.02	.04	.02	.01	
AACA	1.			.09		.02					.06	.07			.02	.02	
	2.		.15	.11	.08		.07		.10	.07	.01					.05	.02
	3.	.04	.01			.01			.10			.05					
ACBA	1.																
	2.			.01		.01	.01			.01	.01			.01		.01	
	3.										.01					.01	
ABAC	1.			.01	.01		.01						.01			.01	.02
	2.				.01					.03							
	3.	.01				.02				.01						.01	
ACAB	1.		.03														.01
	2.					.02								.01			
	3.				.01			.01	.01		.01				.01		.01

Table 3

Mean Number of Words Recalled in Each of 3 Conditions
by Groups Exposed to All Three Conditions

	Condition			
	A	B	C	Total
ABC	4	6.3	4	4.8
ACB	5.3	5.3	2.7	4.4
BAC	6.7	4.3	5.3	5.4
BCA	5.7	4.3	2.7	4.2
CAB	5.7	5	3	4.5
CBA	4	5.3	4.3	4.5
Total Mean	5.2	5.1	3.7	

ANOVA

Source	DF	SS	MS	F
Group	5	8	1.6	<1
Error (a)	12	58.67	4.9	
Condition	2	27.11	13.50	9.50**
Condition X Group	10	34.22	3.42	2.40*
Error (b)	24	34.00	1.42	
Total	53	162.00		

** $p < .01$

* $p < .05$

The analysis of variance of the data is also presented in Table 3. The analysis revealed a significant effect for the conditions in that significantly fewer words were recalled of those presented under the C condition than under the A or B conditions. Apparently the addition of the tone served to distract the subject. The tone may have affected the intelligibility of the word, but this had been checked by a tryout. The significant interaction indicated that the effect of the C condition was not independent of the group. An examination of the means suggest, however, that the C condition mean was generally low. It seems reasonable to conclude that although the attention measure did not reveal any effect related to the C condition, this condition did divert the attention of the subject and the diversion of attention served to inhibit performance.

Discussion

In general the results of this experiment were not encouraging to continued work in this direction. Although a rather strong effect was observed of a stimulus change on performance, it does not appear that the GSR is a measure of attention in this kind of situation. It can be argued that the stimulus change was not of sufficient magnitude to effect a GSR, but the fact that the performance decrement was observed indicates that the stimulus change was of sufficient degree to affect performance. The spacing of the words at two second intervals might have been a methodological error in that the latency for a GSR is from two to five seconds. Even so, a pattern of GSR's should have been observed at a point soon after the stimulus change had the GSR been an adequate measure.

The GSR has been shown to be a measure of arousal level in previous research and it was on this basis that it was selected as a measure for this experiment. It would appear that the level of arousal of the subjects in this experiment was very similar and that the stimulus changes did not affect arousal level but simply served to direct attention to other stimulus components.

We are still of the opinion that attention is a variable that merits study in classroom situations. The measurement of this variable is still a crucial factor, however, in allowing this variable to be studied in any definitive way.

Experiment B*

The stimulus for this experiment was the result of research conducted by Videbeck and Maehr (1966) who investigated the effect of reinforcement (success) on task persistence in high and low risk subjects. Subjects were given the task of judging whether a specific English word was the cognate of a given African word. Reinforcement consisted of the subject being told he was correct. The amount of reinforcement was systematically varied with subjects being divided into four reinforcement groups; 15, 35, 65, and 90 per cent reinforcement. Subjects were also divided into a high risk group, those who would take a chance for a large monetary gain, and a low risk group, those who would prefer not to take a chance and receive a small monetary gain. Subjects were told that they could do as many English-African word pairs as they liked and the criterion measure of persistence was the number of words attempted. The results of this study showed subjects in the high risk group to be significantly more persistent than those in the low risk group. While there was no interaction between level of risk and level of reinforcement there was a significant difference in persistence among the four levels of reinforcement with maximum persistence occurring at the 65 per cent level of reinforcement. These results contradict some traditional notions about the effect of reinforcement which might suggest that maximum persistence would occur at the highest level of reinforcement. Videbeck and Maehr interpreted these results in terms of the individual's need to seek a certain amount of risk, so that the task would be less boring and more interesting. Accordingly, a situation which provided a very high or low level of success would soon become boring to the individual because the lack of risk or challenge involved and result in less persistence in that task. Such speculations seem intuitively sound and their case is strengthened when empirical results show maximum persistence to occur at moderate levels of reinforcement.

A study of Rotter (1966) might have particular relevance to Videbeck and Maehr's study. Rotter found that if a person perceived reward (reinforcement) as being contingent on his own behavior (internal control) he was more likely to raise his expectation

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*This experiment was conducted and the report written by Mr. Thomas J. Lyons, graduate assistant on the project.

after success and lower his expectation after failure than if he perceived the reward as not being contingent on his own behavior (external control). Also those subjects under the internal control situation were more resistant to extinction under 100 per cent reinforcement than 50 per cent reinforcement. The reverse occurred for subjects under the external control situation. Resistance to extinction in Rotter's article was not the same as Videbeck and Maehr's measure of persistence, so direct application of Rotter's findings is not appropriate. However, if these two measures of persistence are measuring the same thing it would suggest that Videbeck and Maehr's task was perceived as an external control situation by subjects engaged in the experiment. If this assumption were true Videbeck and Maehr's results would apply only to external control situations and for internal control situations maximum persistence should occur at the highest levels of reinforcement. At this point it is difficult to speculate on the similarity of Rotter's extinction to Videbeck and Maehr's persistence and the perceived nature of Videbeck and Maehr's task. However, if Videbeck and Maehr's subjects were operating under an external control situation, the results they obtained for persistence would agree nicely with those obtained by Rotter for resistance to extinction.

Rotter's research would indicate the possibility of external and internal control differentially affecting measures of persistence. This being the case, results obtained in studies like Videbeck and Maehr must be interpreted with caution until the nature of the task and the relationship between resistance to extinction and Videbeck and Maehr's persistence is clarified.

The present study does not attempt to solve this problem but does seek to provide additional empirical evidence for different levels of material difficulty. In addition to measures of persistence, the subject's achievement was also measured. The design investigated the effect of reinforcement and perceived material difficulty on a subject's persistence and achievement in a task. As was suggested by Videbeck and Maehr's results, it was hypothesized that persistence would be maximized at moderate levels of perceived material difficulty and reinforcement. A second hypothesis predicted achievement to be directly related to reinforcement and inversely related to perceived material difficulty.

Method

The subjects for the study consisted of 24 senior high school students and 51 college students enrolled in Introductory Psychology. The subjects volunteered for the experiment and were paid one dollar

for participating. The sample consisted of 45 girls and 30 boys who were randomly assigned to an experimental condition as they appeared for the experiment.

The stimulus material consisted of a number of cards on which were typed an English word and six other nonsense words. These cards were divided into three difficulty levels; high, average, and low difficulty. The difficulty of each card was determined by an average rating by at least 40 students as to the difficulty of each item. These students were asked to choose the nonsense word most similar to the English word and then rate themselves on how confident they felt of getting the item correct in terms of a level of probability. A pool of 250 items was constructed and 46 items in each difficulty level were retained for use in the experiment. Items were selected on the basis of low variability and mean values which coincided with one of the three difficulty levels.

Two independent variables were manipulated in the experiment. The first was level of material difficulty and the second was level of reinforcement. In this experiment reinforcement was per cent success a subject had with the items and was under the control of the experimenter. There were five levels of reinforcement: 10, 30, 50, 70, and 90 per cent success schedules. Success was indicated by telling the subject he had gotten the item correct. The two independent variables combined to give 15 different experimental conditions. There were five subjects in each condition for a total of 75 subjects.

Subjects were randomly assigned to an experimental condition as they appeared for the experiment. In the experiment the subjects were told to choose the nonsense word which was most similar to the English word and then rate themselves on the per cent chance of getting the item correct. They were told that they must complete at least 10 items. They were encouraged to do more but told they could quit anytime after completing 10 items. They were also told that they would be asked to recognize the correct words and would be given a short test to measure this at the end of the experiment. Subjects were given items from one of the difficulty levels and reinforcement according to one of the reinforcement levels. After the subject had completed as many cards as he wanted to beyond ten he was given a short test over the cards he had done to see how many of the items he could correctly recognize.

The two criterion measures employed in this study were persistence and achievement. The number of items a subject would do was taken as a measure of persistence. The number of items a subject got correct on a recognition test at the end of the experiment was taken as a measure of achievement. The experimental design consisted

of a 3 x 5 factorial design which was composed of three levels of perceived material difficulty and five levels of reinforcement. An analysis of variance was used for the criterion of persistence and an analysis of covariance was used for the criterion of achievement with the number of items completed serving as a covariate. These two statistical techniques were employed to test the effect of varying levels of perceived material difficulty and reinforcement on the subjects persistence and achievement in the task.

Results

The data from this study are summarized in Table 4. Cell, row

Table 4

Cell Means for Criterion Measures

Reinforcement Level		Difficulty Level: High	Medium	Low	Total
.9	P	18	26.0	25.8	23.3
	R	2.76	3.85	3.56	3.39
	A	12.2	23.0	24.2	19.8 (19.1)
.7	P	26.0	24.8	21.0	23.9
	R	2.11	3.53	4.02	3.22
	A	20.4	20.2	19.6	20.1 (18.9)
.5	P	27.6	27.6	23.8	26.3
	R	2.43	3.34	3.47	3.08
	A	18.6	21.2	17.8	19.2 (16.1)
.3	P	16.0	23.0	20.2	19.8
	R	2.22	2.73	3.05	2.67
	A	10.6	15.6	15.0	13.7 (15.9)
.1	P	21.6	18.2	18.6	19.5
	R	1.58	3.23	2.79	2.53
	A	15.8	13.4	15.0	14.7 (17.2)
Total	P	21.8	23.9	21.9	
	R	2.22	3.34	3.38	
	A	15.5 (14.9)	18.7 (17.5)	18.3 (18.8)	

P = Persistence
R = Rated probability of success
A = Achievement

and column means are presented for measures of persistence, rated probability of success, and achievement. Row and column means for the achievement measures in parentheses are adjusted on the basis of the covariate.

The first hypothesis stated that persistence would be a maximum at moderate levels of reinforcement and perceived material difficulty. The analysis of variance summarized in Table 5 was used for

Table 5

Summary of ANOVA for Difficulty and Reinforcement Conditions: Persistence Criteria

Source	df	SS	MS	F
Difficulty (D)	2	70.75	35.38	<1.00
Reinforcement (R)	4	512.74	128.18	1.55
D x R	8	412.30	51.54	<1.00
Within	60	4950.80	82.51	
Total	74	5946.59		

SD = 8.70 Mean = 22.55

testing this hypothesis. No significant differences among levels of perceived material difficulty or achievement were found. Although the first hypothesis was not statistically supported, Figures 1 and 2 show that maximum persistence was achieved under the 50 per cent reinforcement condition and under material of medium difficulty. These results do support the first hypothesis and the lack of statistical significance may well have been a result of uncontrolled variables. This possibility is discussed in the concluding section of this report.

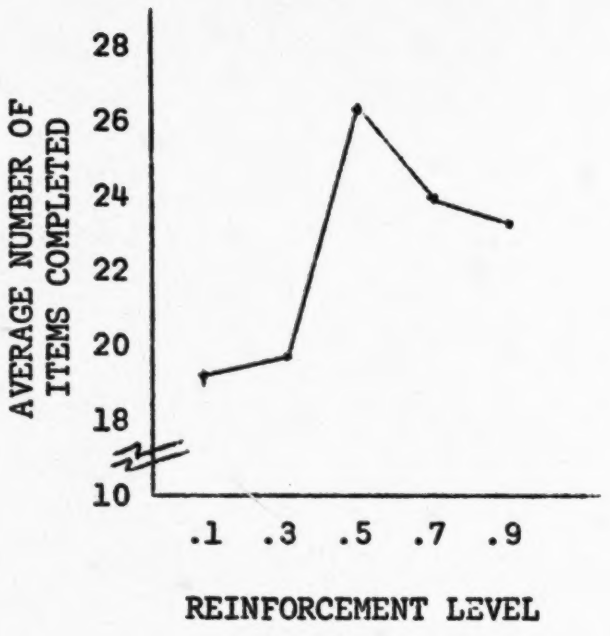

Figure 1 The average number of items completed (measure of persistence) for each level of reinforcement.

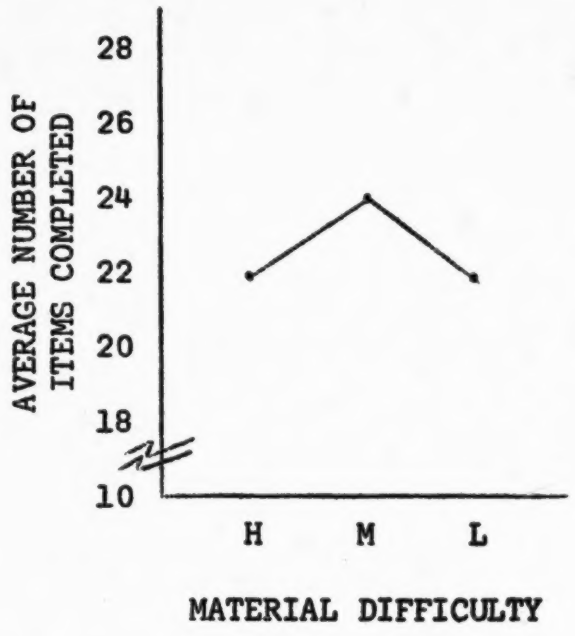

Figure 2 The average number of items completed (measure of persistence) for each level of material difficulty.

The second hypothesis stated that achievement would be directly related to reinforcement and inversely related to perceived material difficulty. The analysis of covariance summarized in Table 6 was used for testing this hypothesis. There was a significant difference

Table 6

Summary of Analysis of Covariance (# trials as the covariate) for Difficulty and Reinforcement Conditions: Achievement Criteria

Source	df	SS	MS	F	P
Difficulty (D)	2	95.75	47.87	6.74	<.005
Reinforcement (R)	4	136.19	34.05	4.79	<.005
D x R	8	53.45	6.68	<1.00	
Within	59	419.32	7.11		

SD = 8.08 Mean = 17.51

($p < .005$) among levels of reinforcement and perceived material difficulty in the direction predicted by the hypothesis. Figures 3 and 4 show both the observed mean values and the adjusted mean values for the achievement measure. A large portion of the variance in this analysis (85%) was extracted by the relationships between the covariate (number of trials) and the criterion measure. An analysis of variance which did not use a covariate showed results very similar to those obtained for the persistence criterion. Had there been an appropriate covariate available for the analysis of the persistence criterion, significant results may very well have been obtained, as they were for the achievement criteria.

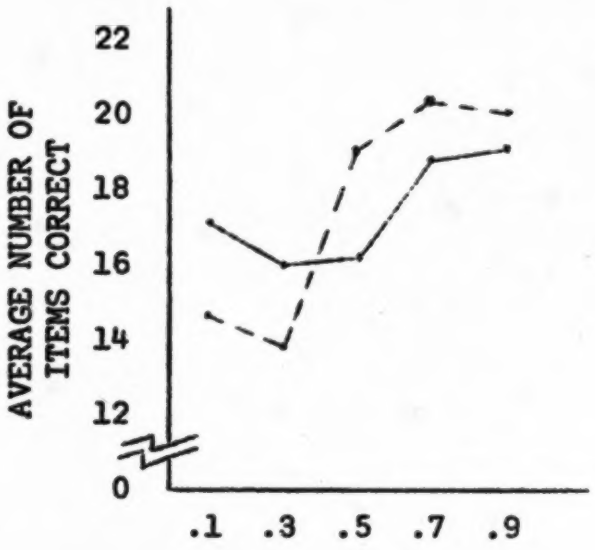

Figure 3 The average number of items correct (measure of achievement) for each level of reinforcement; ---- observed mean values, ____ mean values adjusted on the basis of the covariate.

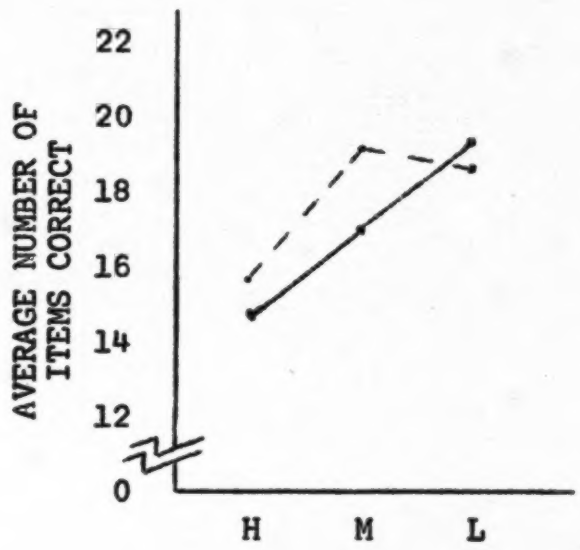

Figure 4 The average number of items correct (measure of achievement) for each level of material difficulty; ---- observed mean values, ____ mean values adjusted on the basis of the covariate.

It would appear that task persistence was maximized at moderate levels of reinforcement and perceived material difficulty, though this trend was not statistically significant. Task achievement was directly related to reinforcement and inversely related to perceived material difficulty when number of trials was used as a covariate.

An additional analysis investigated the effect of reinforcement and perceived material difficulty on ratings of item difficulty by subjects. The average difficulty per subject for items completed

was used as the criterion measure. An analysis of variance summarized in Table 7 was used for investigating this analysis.

Table 7

Summary of ANOVA for Difficulty and Reinforcement Conditions: Rating Criteria

Source	df	SS	MS	F	P
Difficulty (D)	2	21.5817	10.7908	16.91	<.005
Reinforcement (R)	4	7.9814	1.9953	3.13	<.05
D x R	8	3.7072	0.4634	<1.00	---
Within	60	38.2918	0.6382		
Total	74	71.5621			

SD = 0.97 Mean = 2.98

Ratings of item difficulty were directly related to reinforcement and inversely related to perceived material difficulty. Figures 5 and 6 graphically present these results. The results showed that

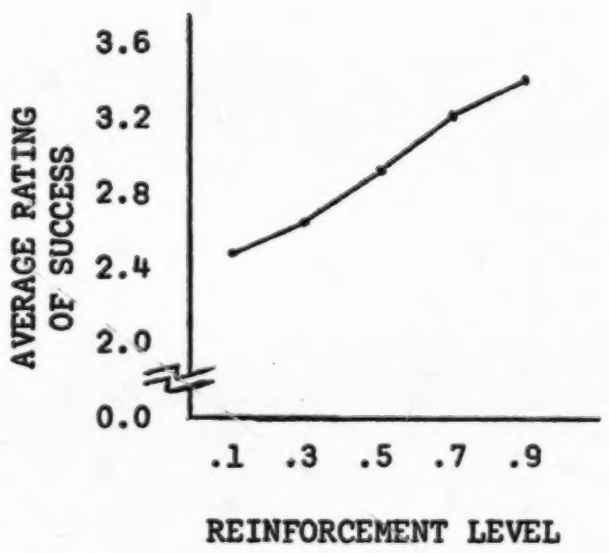

Figure 5 Subjects average rating of success for items at each level of reinforcement.

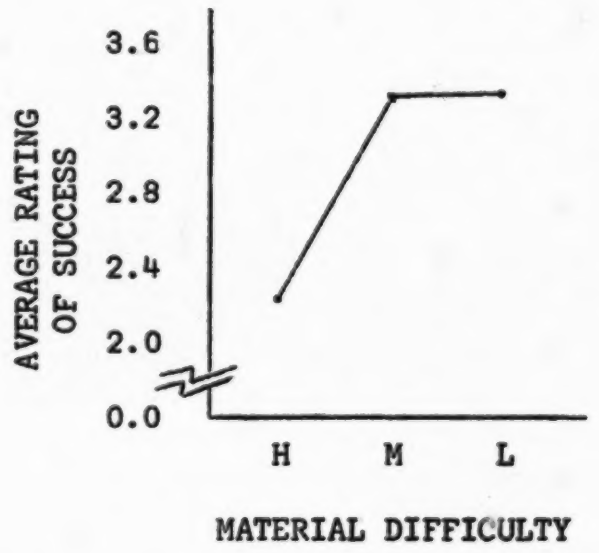

Figure 6 Subjects average rating of success for items at each level of material difficulty.

in the experimental situation both conditions of reinforcement and perceived material difficulty had a significant effect on a subject's rating of item difficulty. These results would seem to indicate that the independent variables of reinforcement and perceived material difficulty were having the desired experimental effect on the subjects in this experiment.

Discussion

The results obtained in this study support the findings of Videbeck and Maehr (1966) who found that persistence was greatest at moderate levels of reinforcement. In addition to this, moderate levels of perceived material difficulty were also found to result in the greatest amount of task persistence. In the present study these differences were not statistically significant due to a large within group variance. Research cited by Atkinson and Feathers (1966) gives two variables which have a pronounced effect on persistence. These two variables are the subjects achievement motivation and the subjects perception of the task as an ego or chance related situation. Neither of these two dimensions were controlled for in the present study and if they had been, the within group variance could have probably been markedly reduced. Atkinson and Feathers found that subjects who are achievement oriented persist longer in tasks which are about medium in difficulty level while subjects who are not achievement oriented persist longer on tasks which are very difficult or very easy. This dimension if not controlled could significantly increase error variance. As was noted by Rotters (1966) the subject's perception of the situation as a chance or ego related one was important in determining what level of reinforcement maximized persistence. In the present study it is difficult to determine how the subjects perceived the items. Logically one might hypothesize that when the level of reinforcement matched the level of perceived material difficulty it would be more likely for the subject to perceive the situation as being ego related than when the level of reinforcement was quite different from the level of perceived material difficulty. If this were the case, and it were not controlled for, error variance would be further increased. It would seem necessary that further research in the area of persistence should control for these two important variables.

In contrast to the persistence criterion, this study found that achievement was maximized at the highest level of reinforcement and at the easiest level of perceived material difficulty. Since both achievement and persistence in a task might very well be desirable outcomes in a learning situation some sort of compromise

between the two would seem to be necessary to maximize overall objectives. Speculations of this nature are perhaps premature and should wait until further research with a variety of stimulus materials in different experimental situations is conducted. Nevertheless research to date suggests that reinforcement might very well have a differential effect on persistence and achievement in a task.

Chapter 4

SCALING OF CLASSROOM TASKS

The original intent of this project was to design some pilot experiments on attention in the classroom using an attention measure that was to have been developed out of the experiment reported above. Obviously the design of such experiments was not accomplished because of the lack of success in developing the attention measure. Some work was done, however, on one aspect of a classroom design and this work is reported in this chapter.

One problem with much educational research is the limited generalizability of the results. Part of this limited generalization stems from limitations in the sample of students used in many studies. This limitation has been discussed well in most textbooks on educational research. Less attention, however, has been given to another sampling limitation in educational experiments, that of the learning task and materials. The results of a majority of the experiments reported are specific to the task and the materials used. Seldom are the materials or the tasks samples of some universe of materials or tasks. In the opinion of this investigator, it would be very desirable if experiments were designed when feasible so that the results might be generalized not only to a student population, but also to a population of tasks and/or materials.

The purpose of the study reported in this chapter was to attempt to identify a population of learning tasks that could be used for experiments in attention in the classroom. If such a population could have been identified, then the intent was to design experiments in which the experimental treatments would be applied to a sample of the learning tasks and thus permit generalization to the population of learning tasks.

Method

The definition of a population of learning tasks is a difficult task in its own right. In our opinion the population should exhibit the following characteristics:

1. The tasks should be similar in content.
2. The tasks should be similar in difficulty.
3. The tasks should be independent.
4. The tasks should be of similar length.

Two approaches to the identification of a population of tasks were considered. One approach that was considered was to select tasks and attempt to analyze the tasks according to the "hierarchy of subordinate knowledges" notion presented by Gagne (1962). In this approach one would group those tasks that exhibit similar "hierarchies."

The second approach that was considered and used was a modified multidimensional scaling approach. (Torgerson, 1958). In multidimensional scaling a group of judges make judgments of the similarity of stimulus objects. When the judgments are analyzed with a factor analysis, the ensuing factor matrix consists of factors that define the dimensions used by the judges in making their judgments. It was reasoned that if such an approach were used in judging similarity of learning tasks, the ensuing factor matrix would in effect consist of factors such that those learning tasks with high loadings on a factor would be a defined population of learning tasks.

We had no strong basis for selecting the multidimensional approach over the "hierarchical" approach. Hopefully the hierarchical approach can be tried with the same group of tasks as were used in this study in order to obtain a comparison of the two methods.

It was decided to attempt to identify a population of tasks from units of instruction in 10th grade vocational agriculture. An outline of 10th grade topics was obtained from each of fifteen teachers of vocational agriculture. From these outlines, twenty topics were selected. The topics were mentioned on at least 10 of the course outlines and were selected so that there was some redundancy in content and length of the unit. The selected topics are shown in Table 8.

Table 8

Selected Learning Tasks for Judging Task

Striking an arc
Setting up a survey instrument
Brazing
Soldering
Laying out contour lines
Butt welding (acetylene)
Timing an engine
Land classification
Saw sharpening
Weed identification
Cattle diseases
Parasites in swine
Seed germination
Using the square
Preparation of mortar
Grass identification
Soil testing
Electrical system of small gas engine
Rafter cutting
Welding cast iron (arc)

The twenty topics were judged by twenty-five vocational agriculture teachers. These teachers were a different group than the fifteen who submitted the course outlines. The judges were presented with twenty judging tasks. Each time a different topic was made the criterion. The judge was instructed to rank the other nineteen topics in terms of how similar each was to the criterion in complexity of the topic and the amount and kind of prior knowledge needed. The most similar topic was given a rank of one and the least similar topic a rank of nineteen. The procedure was repeated 20 times so that each topic had been used as the criterion.

The differences between assigned ranks for topics were squared for each judge and the differences were summed across judges. This difference matrix was not symmetric. For example the entry in row 1, column 2 was obtained from all judgments with topic 1 as the criterion and the ranks assigned to topic 2 whereas the entry in row 2, column 1 was obtained from the judgments with topic 2 as the criterion and the ranks assigned to topic 1. To make the matrix symmetric, the average of the row i, column j and row j, column i elements was inserted into the cell. Each element in the matrix was then divided by the largest difference in the matrix and the matrix was subtracted from a unit matrix. The resultant matrix was a symmetric matrix with values ranging between zero and unity. A value of unity indicated maximum judged similarity and a value of zero indicated minimum judged similarity between topics. This matrix was factor analyzed by the principal axis procedure and the factor matrix was rotated to the varimax criterion.

Results

The rotated factors that resulted are shown in Table 9. Only those topics with loadings greater than .50 on a factor are shown in the table.

The results suggest that the 20 topics consist of three or four populations. The topics on Factor V are included in Factor I. Factor I seems to consist of topics that cut across content lines and for this reason might be a very useful grouping of topics from which to select for experiments. Factors II, III, and IV are rather consistent in terms of similar content. Thus Factor II is a welding topic factor, Factor III primarily an electrical topic factor, and Factor IV a carpentry topic factor. Factor V although included in Factor I seems to consist of animal disease topics. Each of these factors also define groups of topics that would serve well for sampling in experiments. One possible limitation on their usefulness would be a lack of independence between the topics. If one

Table 9

Clusters of Learning Tasks Formed from Judgments of Degree of Complexity of the Task. (The loadings indicate relative strength, but should not be interpreted as correlation)*

Factor I	Loading	Factor II	Loading
Grass identification	94	Brazing	88
Land classification	93	Soldering	85
Weed identification	92	Striking an arc	85
Seed germination	89	Butt weld (acetylene)	83
Soil testing	88	Weld cast iron (arc)	53
Laying out contour lines	81		
Setting up a survey instrument	79		
Cattle diseases	73		
Parasites in swine	70		

Factor III	Loading	Factor IV	Loading
Timing an engine	92	Using a square	79
Electrical system of small gas engine	90	Rafter cutting	77
Weld cast iron (arc)	51	Saw sharpening	76

Factor V	Loading
Parasites in swine	66
Cattle diseases	63

*Decimal points are omitted on the loadings.

of the topics is a needed prior learning for another of the topics then these two topics would not be desired in the same experiment. For example, in Factor III the two topics "Timing an engine" and "Electrical system of a small gas engine" are probably not independent in that the study of electrical systems would likely precede the study of timing. Consequently, these two topics would not likely be used in the same experiment.

It is recognized that the obtained factor structure is a function of the specific topics used in the judgment task. Had other topics been included a different structure might have resulted. Despite this limitation, however, it does appear that an approach such as the one used can be helpful for identifying a population of topics that can be used to enhance the generalizability of an experiment. This can be accomplished by designing the experiment so that the treatments are applied to the population or to a sample from the population.

Chapter 5

SUMMARY

The reported project consisted of four discrete aspects. The research literature on the topic of attention was reviewed and certain implications for classroom practice were drawn. Novelty, variety, change, and complexity seemed to be the variables that were related to increased attention. The relationship between these variables and attention, however, is probably curvilinear so that the teacher should guard against too much as well as too little use of these in her presentations.

Attention in the classroom is an important variable, but it has not been studied in any definitive way. One reason for this lack of study is probably because of the difficulty of measuring attention. An experiment was conducted in an attempt to determine overt behavioral correlates of a physiological measure of attention. An experiment was conducted in an attempt to determine overt behavioral correlates of a physiological measure of attention. GSR records were made of subjects while they listened to a list of CNC words. The 32 words were presented in blocks of eight and the presentation of the blocks was varied by changed tone or addition of a tone. No systematic effect was observed on the GSR of the subjects due to the stimulus changes. Consequently, no overt behavioral correlates could be related to the GSR. The stimulus changes apparently affected the recall of the words. Those words that were presented with an accompanying tone were recalled significantly less well than words presented with no additional tone.

Another experiment was conducted to study the relationship between persistence and task difficulty. It was predicted that subjects exposed to a task of medium difficulty would persist longer at the task than subjects exposed to a very easy or very difficult task. The results, while not statistically significant, were in the predicted direction. The results were discussed in relation to need for achievement and feelings of competence.

The fourth discrete aspect of the project was to attempt to define a population or populations of learning topics from 10th grade vocational agriculture. The purpose of the study was that if a population of topics could be identified, then experiments might be designed to apply the treatments to the population or samples from the population. This would permit greater generalizability of the results than the usual case where the experiment is conducted on one topic. A modified multidimensional scaling approach yielded five factors among 20 topics judged by vocational agriculture teachers in terms of similarity. At least four topic populations seemed to be present among the 20 topics.

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